

High-resolution global land cover maps for national-level area change estimation and reporting : case study for Uganda

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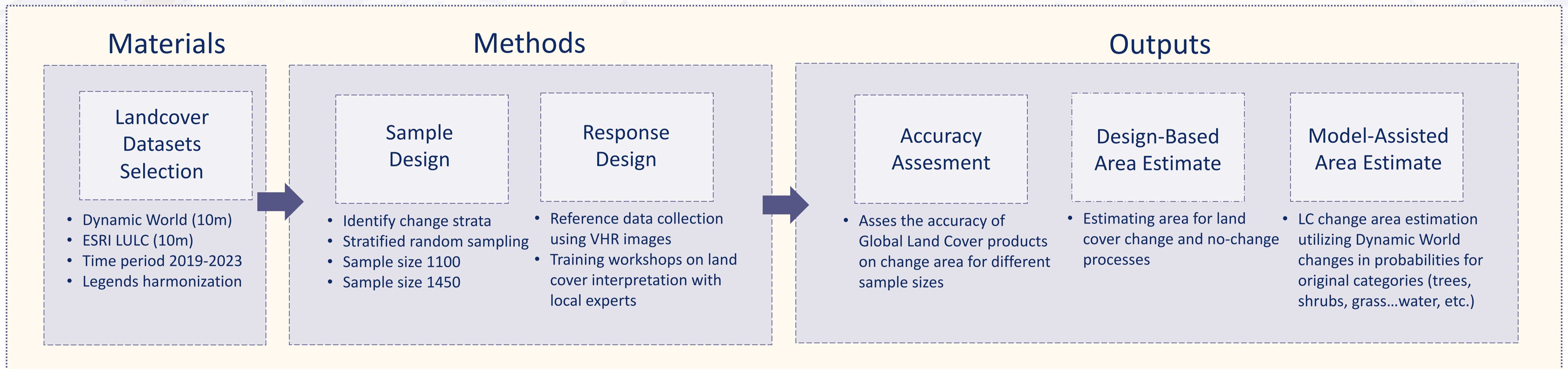
Motivation:

Accurate estimation of land cover (LC) change is essential for national monitoring and reporting of land-use dynamics. Recently developed multi-year 10m global land cover (GLC) products, such as Dynamic World (DW) and ESRI LULC offer a new opportunities for multi-year change assesment but require validation of their reliability and uncertainty. This study evaluates these products for estimating land cover change in Uganda for the period 2019-2023 and provides accuracy assesment. Reliable LC change estimates are especially important in developing countries, where AFOLU contributes substantially to GHG emissions and transparent reporting supports progress towards sustainability goals.

Objectives:

- Assess the effectiveness and accuracy of both Dynamic World and ESRI LULC for national LC change assessments
- Develop and demonstrate a statistically robust approach for LC change area estimation utilizing GLC maps in Uganda
- Compare Design-Based and Model-Assisted sampling frameworks to estimate key AFOLU and LDN related LC changes and their uncertainties

Conceptual framework



Results

Accuracy Assesment for Dynamic World and ESRI LULC:

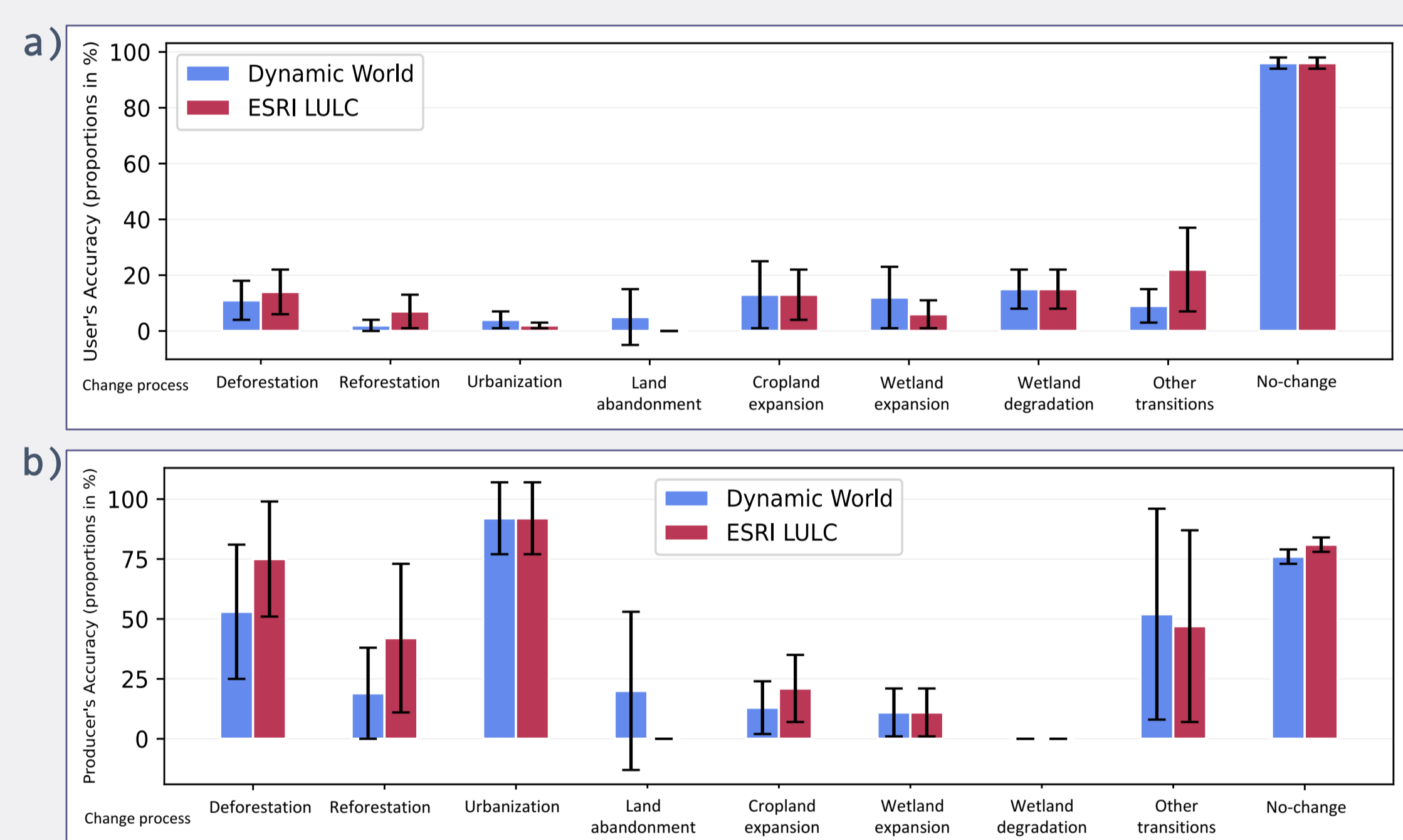


Figure 1. Accuracy assesment for Dynamic World and ESRI LULC maps with sample size 1450: a) on User's accuracy performance, b) on Producer's accuracy with associated uncertainties (95% CI) for Uganda.

Change area estimate in Uganda:

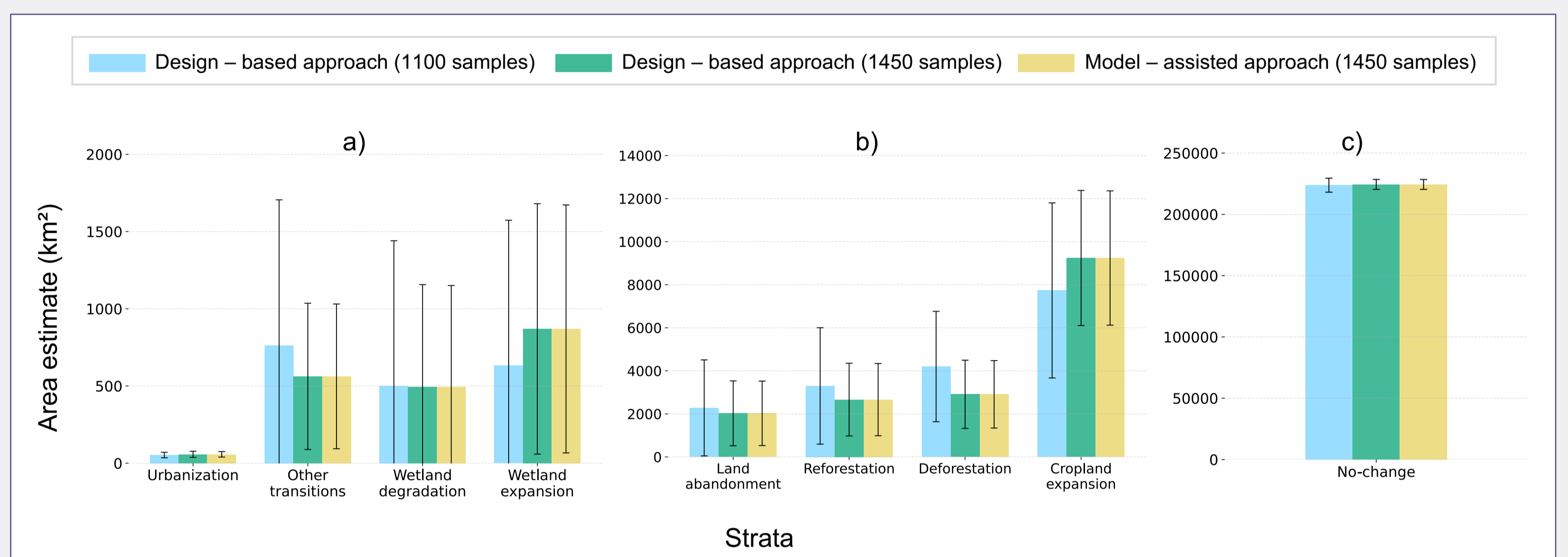


Figure 2. Land cover change area estimates for change processes in Uganda related to the AFOLU sector using two approaches: design-based and model-based estimators with associated uncertainties (95% CI). For model assisted approach, Dynamic World probabilities are used as covariates.

Sample Design:

Harmonized label	Trees	Low vegetation	Cropland	Settlement	Other lands	Wetlands
Trees	No change	Deforestation	Deforestation	Deforestation	Deforestation	Deforestation
Low vegetation	Reforestation	No change	Cropland expansion	Urbanization	Other transitions	Wetland expansion
Cropland	Reforestation	Land abandonment	No change	Urbanization	Land abandonment	Wetland expansion
Settlement	Reforestation	Other transitions	Other transitions	No change	Other transitions	Wetland expansion
Other lands	Reforestation	Other transitions	Cropland expansion	Urbanization	No change	Wetland expansion
Wetlands	Reforestation	Wetland degradation	Wetland degradation	Wetland degradation	Wetland degradation	No change

Table 1. Transition matrix representing land cover changes classes based on harmonized original legends of DW and ESRI LULC with adaptation to IPCC land categories

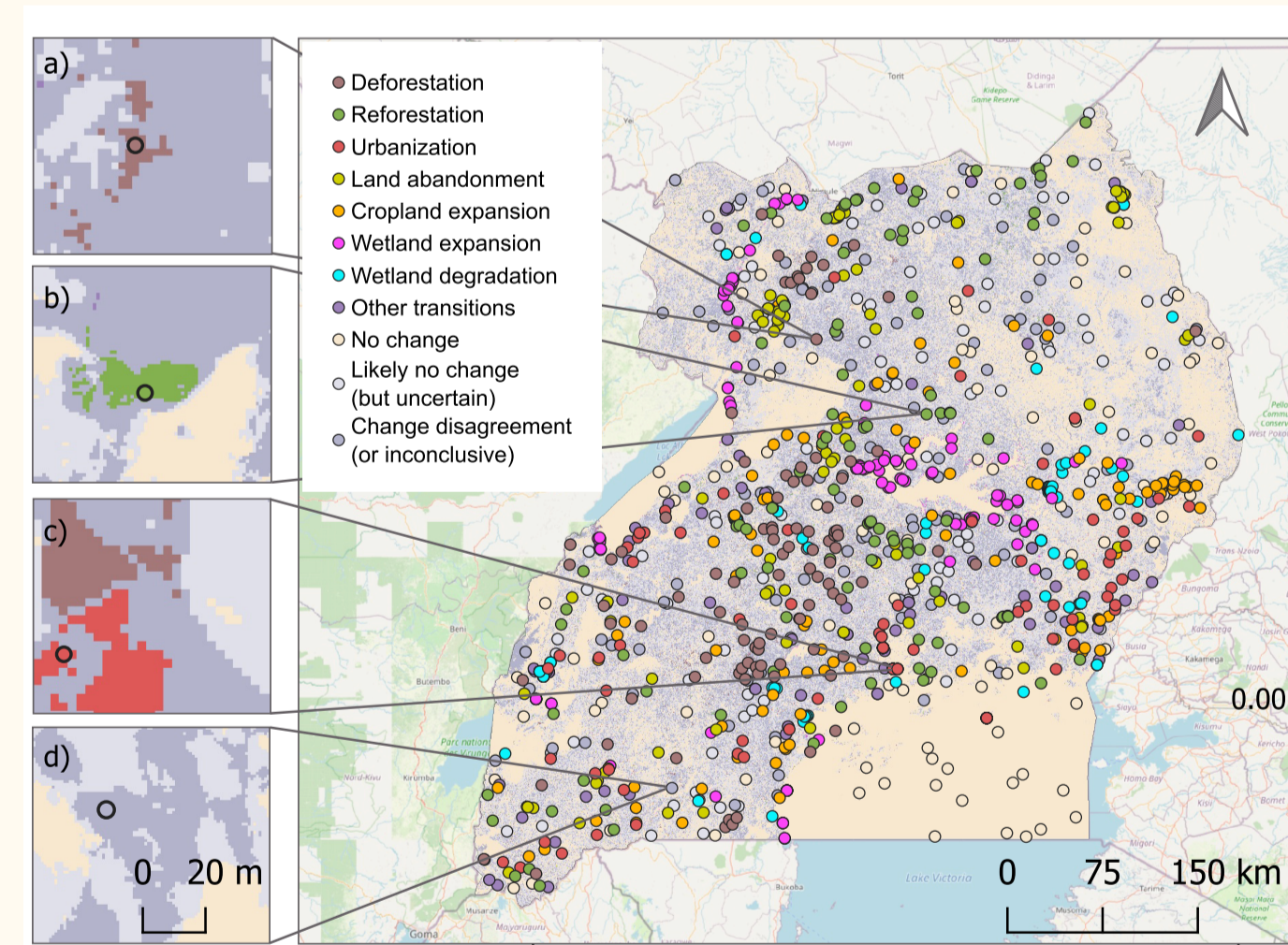


Figure 3. Representation of reference data spatial distribution (example for 100 samples per strata) with zoomed: a) deforestation, b) reforestation, c) urbanization, d) change disagreement or inconclusive.

Response Design:

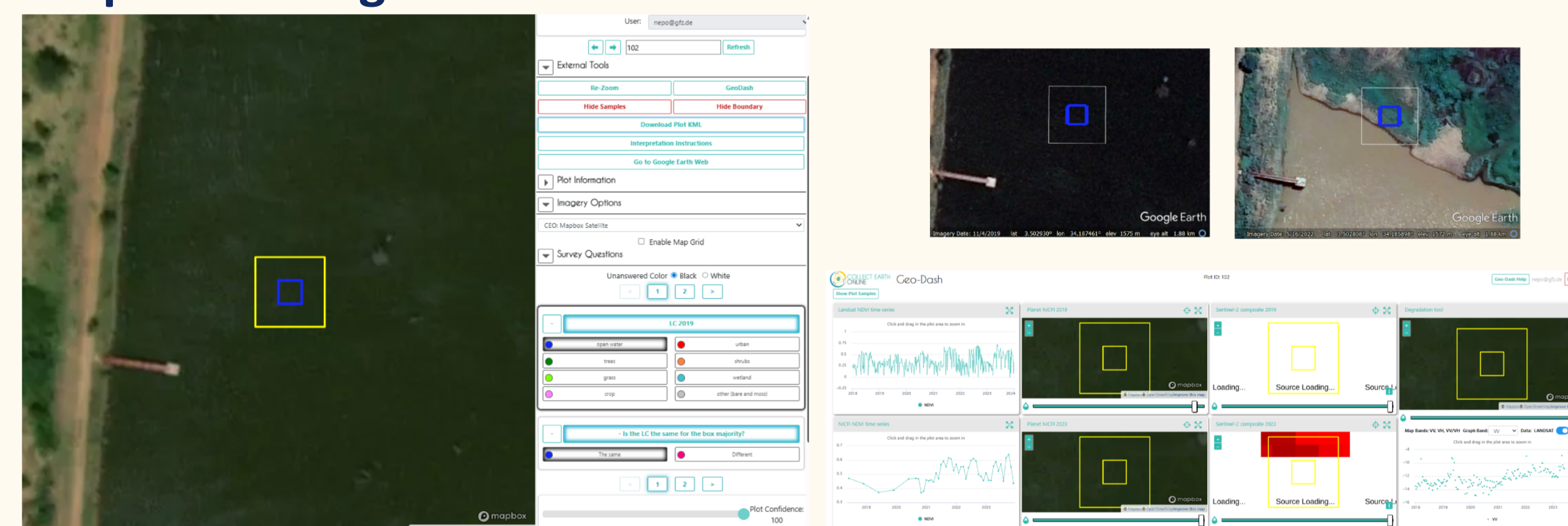


Figure 4. Example of reference data collection and interpretation within Collect Earth Online environment, online open access web platform.

Summary

- Overall accuracy for land cover changes in Uganda comprised **71,89% ± 2,57% for Dynamic World**, and **76,67% ± 2,47% for ESRI LULC**.
- Despite the high spatial resolution, **both products are not yet suitable for direct use in national reporting**.
- Integration of **model-assisted approach** for change area evaluation resulted in limited gains in precision, highlighting **potential as a complimentary framework** for future national-scale assessments.
- Both products are valuable at national-level as a foundation for stratified and statistical inference, supporting methodological consistency and transparency.

Research in progress...

- The expanded regional research across the **African continent** is currently underway, focusing on the systematic comparative evaluation of multiple GLC maps: **DW, ESRI LULC, FCS30D, GLAD** for LC change accuracy assesment and area estimate for **two periods 2016-2020 and 2020-2024**.
- A similar methodological framework will be implemented, incorporating **good practices in sampling design and statistical inference** to ensure robust assesment.
- **Reference data collection** for LC change area assesment will be conducted in close collaboration with regional scientists and interpreters.

References: Tyukavina, A., Stehman, S. V., Foody, G. M., Bontemps, S., See, L., Olafsson, P., Tsendbazar, N. E., Radoux, J., Komarova, A., Serre, B. M., Song, X. P., d'Andrimont, R., Koren, G., Potapov, P., Bullock, E. L., Campbell, P., de Bruin, S., Defourny, P., Friedl, M. A., Fritz, S., Hansen, M. C., Herold, M., Lamarche, C., Lesiv, M., Mane, L., Meroni, M., Nickeson, J. E., Pelletier, F., Pickens, A., Reiche, J., Schepaschenko, D., Tarrío, K., Verhegghen, A., Woodcock, C., & Xiao, X. (2025). Land cover and change map accuracy assesment and area estimation good practices protocol (Version 8.1). In A. Tyukavina, S. V. Stehman, G. Foody, S. Bontemps, A. Komarova, N. E. Tsendbazar, & J. Nickeson (Eds.), Good practices for satellite derived land product validation (p. 187). Land Product Validation Subgroup (WGCV/CE05). https://doi.org/10.5867/gc.cceosgwcv/tpv/v1/c_08